

PAGAN newsletter 1985

Strengthening Pagan monuments

The implementation of strengthening measures against seismic hazard (see *Pagan Newsletter 1983*) started this year on two selected monuments:

The Kyaukku Umin temple 154 is a very special case amongst Pagan monuments, from several points of view. Located at the north-east border of the archaeological area, near Irrawaddy River, the temple was built along the steep edge of a ravine; its ground floor, level with the bottom of the ravine, opens to the north and is centered on a vaulted shrine surrounded by a corridor. Two large pillars support the vaults, while the back wall is built against the cliff, under which tunnels have been dug. The upper storey, built later on the terrace, comes to the level of the alluvial plateau. Another rare feature is the sandstone facing of its walls, outside as well as inside, the usual brick masonry being thus restricted to the inner part of the walls and to the upper storey. Very fine 12th century stone carving adorns the ground floor, outside and inside.

After the 1975 earthquake, several vertical cracks were observed in the walls. Further analysis revealed that these cracks originated from before the shock, which merely widened them, and the structural analysis showed that the original building was strong enough to withstand severe earthquakes. The restoration of its initial structural integrity, which is thus sufficient to meet the specified seismic criteria, has been achieved with two L shaped reinforced concrete belts, inserted in the upper parts of the walls, behind the cornice of each storey. In addition, local reinforcements and injections will be carried out along the former cracks.

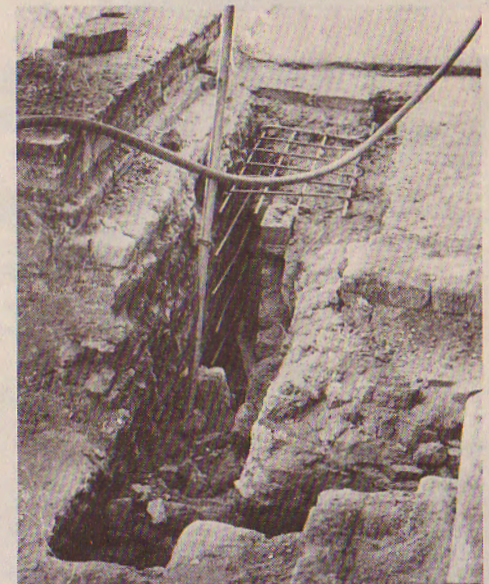
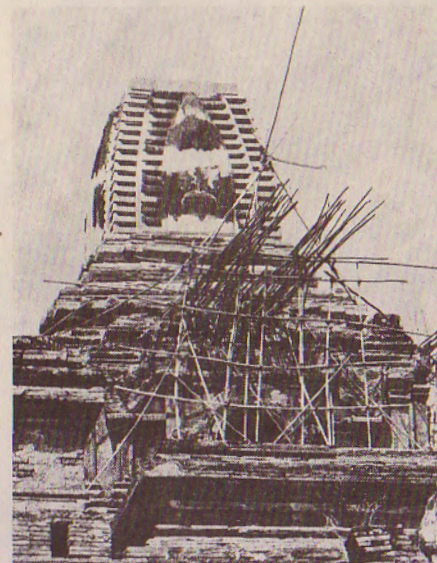
The South Guni temple 765 is a typical two-storey temple (see *Pagan Newsletter 1984*). The 1975 earthquake inflicted longitudinal cracks in the vaults of the ground floor and severe dislocation of the upper storey.

The structural analysis confirms that a general strengthening of the masonry is necessary to obtain the requisite tensile resistance under seismic conditions. Steel ties will be inserted in the whole length of the walls at critical levels, combined with masonry injections, all of these to be carried out in 1986 after delivery of the

specific equipment in Pagan. In 1985, the local reinforcement of the crowning tower was completed by inserting a light reinforced concrete frame into its masonry, and preparatory steps such as a general pointing of the brick joints were undertaken.

In preparation for the placing of steel ties in the walls, tests on deep boring into Pagan brick masonry were also performed, using the wagon-drill provided by the project.

Strengthening the tower of South Guni 765.



Completing the reinforced concrete belt on Kyaukku Umin 154.

Conservation of mural paintings and stuccoes in Pagan

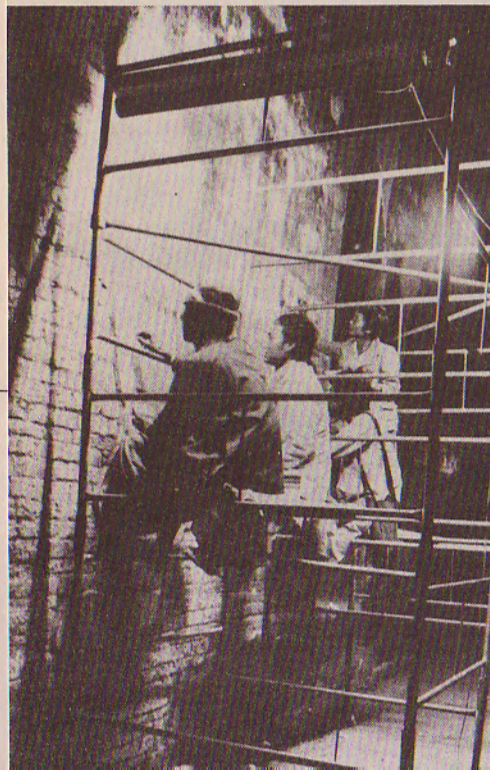


Kubyaukgyi Temple 1323:

After treatment, painting of Skanda Kārttikeya guarding the entrance to the central shrine.

Conservation work on the paintings in the south corridor.

Clearing the stucco mouldings, north-east corner.



The third workshop on paintings and stucco conservation was carried out in Kubyaukgyi Temple 1323 (see *Pagan Newsletter* 1982 and 1983) from 27 December 1984 to 21 January 1985. Restorers Donatella Zarri, Carlo Giantomassi and Paul Schwartzbaum resumed the treatment of mural paintings in the south corridor and began cleaning and preservation treatment of the stucco carving on the north wall of the temple. They were assisted throughout the whole session by 19 Burmese trainees from Pagan, Mandalay and Rangoon.

After removal of a polyvinyl acetate layer applied during a previous restoration, using a mixture of butylamine, acetate and water in equal parts, with 24 hours pauses to avoid damaging the original pigment layer, the dirt, composed of dust, soot, insect or bat dropping, and possibly an old fixative, was carefully removed by an equal-part mixture of hydranal (a disodium salt of ethylene-diamine-tetraacetic acid) and a 10% aqueous solution of ammonium carbonate, applied through cellulose-pulp compresses or through a sheet of local tissue-paper for about 6-8 minutes.

Additional fine cleaning was performed after pauses of 24 hours to allow the pigment layer to regain its strength. Consolidation of the support was made by injections of local sifted earth mixed with primal AC33 (acrylic resin water emulsion) in all hollow places, detached areas and insects tunnels.

The cleaned painting was provided a final protection by a reversible solution of paraloid B 72 in toluene (3%).

The external stuccoes were cleaned of dust, mosses and lichens by sponges and brushes after dampening of the surface. They were also consolidated and fixed by a mixture of:

- one part hydraulic lime (chaux blanche Lafarge)
- one part brick powder (sifted on 150 mesh)
- primal, 5% of the volume of the dry lime
- sodium gluconate 10% water solution, 1% of the volume of the dry lime
- water as required.

The Burmese trainees, under the leadership of U Ba Tint and U Aye Maung (Archaeology Department), took part in all steps of the process and were able to carry on after the departure of the foreign experts. The final aim, to provide Burma with a local permanent team, technically able and self-sufficient, is well under way.

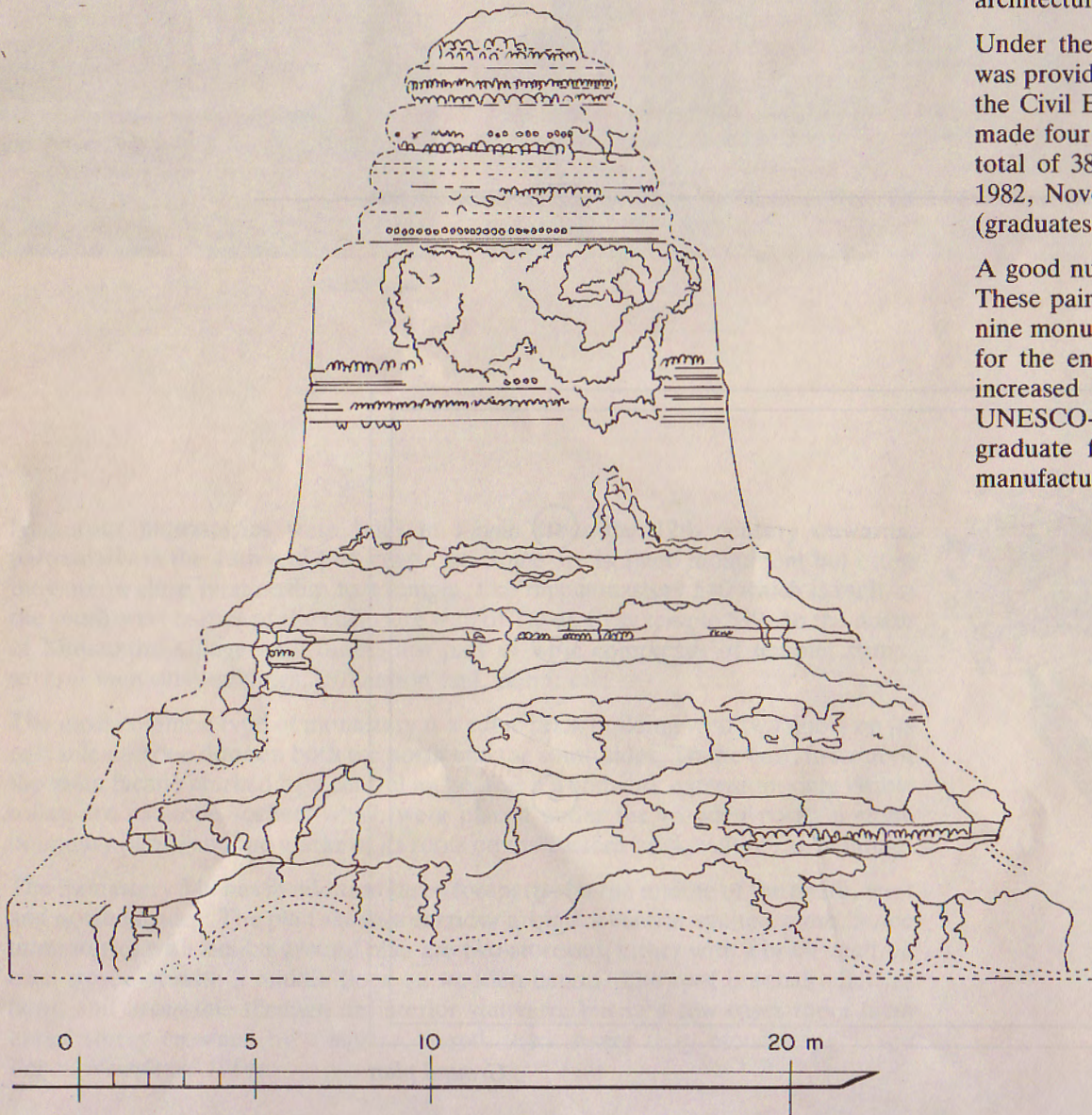
A total of 18.4 m² of paintings have been treated in Kubyaukgyi temple so far, which is about 20% of the present surface. Another workshop is scheduled for next year on the same monument for more advanced training. Lighting equipment will be provided by the project to enable visitors to enjoy the full impact of the restored paintings.

Photogrammetric recording of Pagan monuments

In 1976, one year after the earthquake, a photogrammetric mission, carried out by the French *Institut Géographique National*, recorded 16 monuments in Pagan, the drawings of which (elevations and some details) were later delivered to the Burmese authorities. In addition, two fellowships to train Burmese specialists on architectural photogrammetry were given by the French Government.

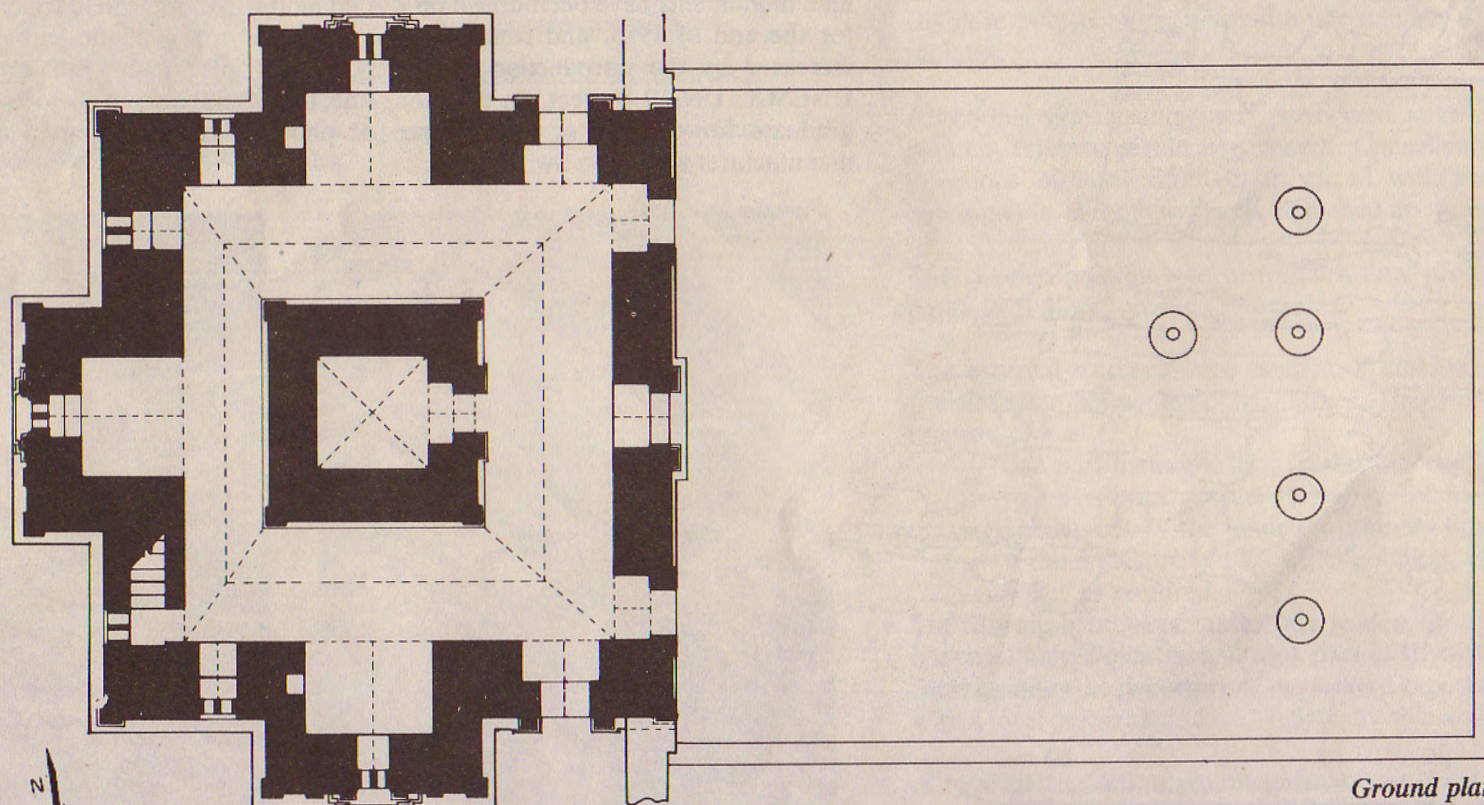
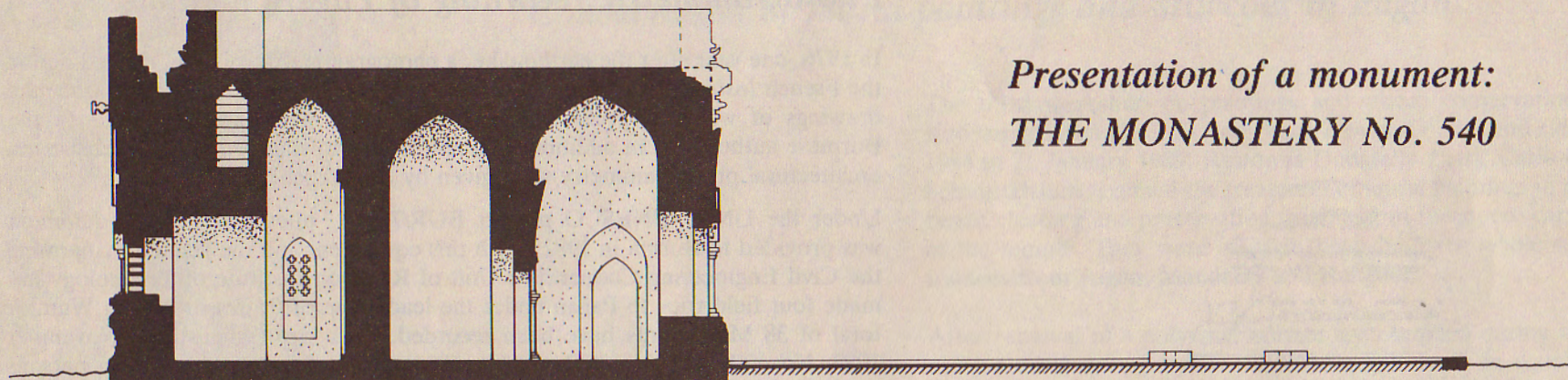
Under the UNDP-UNESCO project BUR/78/023, photogrammetric equipment was provided to Burma in 1982. With this equipment and the trained manpower, the Civil Engineering Cooperative Unit of Rangoon Institute of Technology has made four field trips to Pagan under the leadership of Professor U Min Wun. A total of 38 Monuments have been recorded. Each trip (August and November 1982, November 1983 and December 1984) included approximately ten persons (graduates and students of R.I.T.) and lasted about two weeks.

A good number of stereopairs have been made, using a P 32 terrestrial camera. These pairs are stored at R.I.T., and the architectural elevations and sections of nine monuments have been drawn on a A 40 plotter. Another field trip is planned for the end of 1985, and from 1986 the pace and range of the survey will be increased by the introduction of a P 31 camera, also to be provided by the UNESCO-UNDP project. In addition, one fellowship was given to a Burmese graduate for training in maintenance of photogrammetric equipment, at the manufacturer's plant in Switzerland.

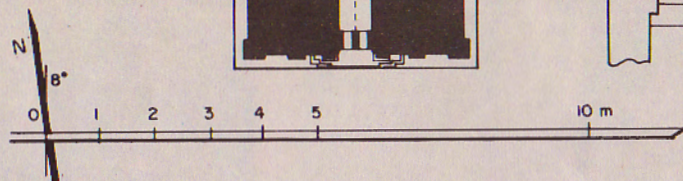


Innphaya Stūpa 772
Photogrammetric elevation.

Presentation of a monument:
THE MONASTERY No. 540



Ground plan

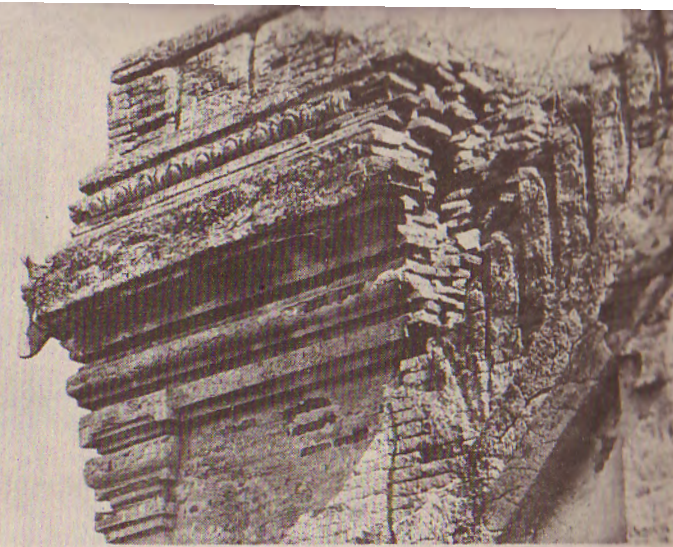




South face.



East face.

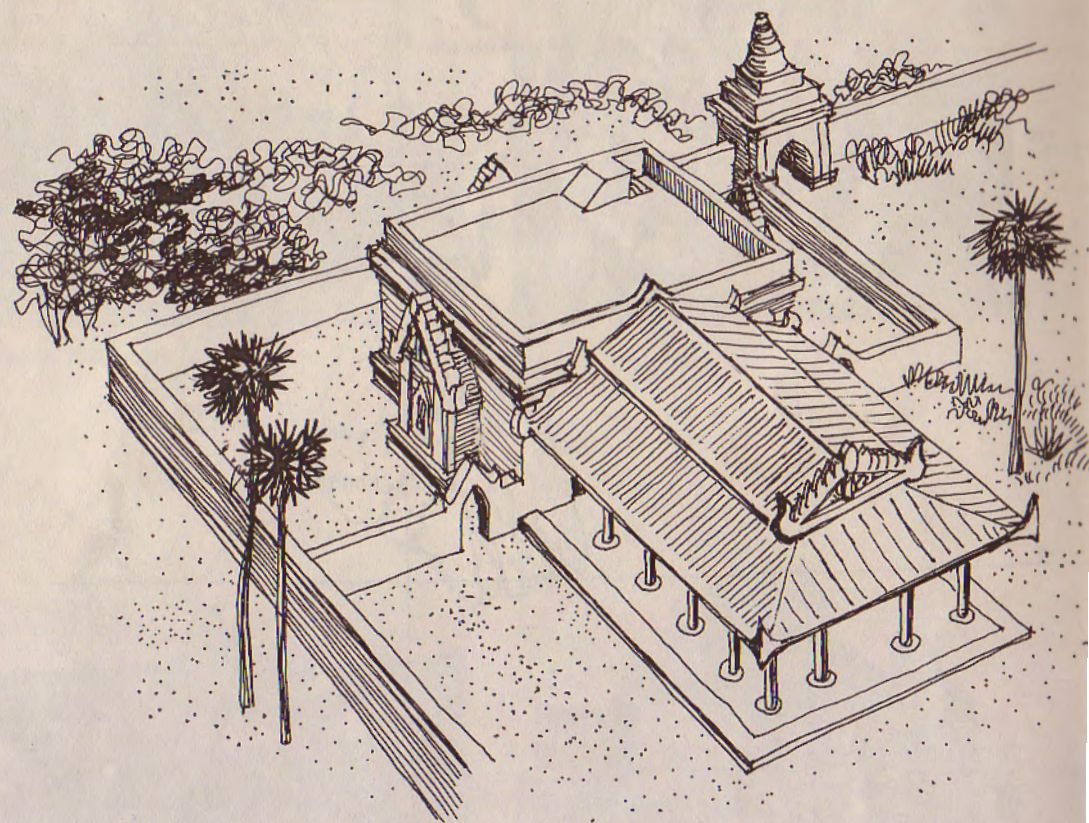


Cornice, west face, north-west corner.

Numerous monasteries were built in Pagan from the 12th century onwards, particularly in the 13th and 14th centuries. Some are isolated monument but often they are in close relationship to a temple, like this monastery 540 which is built in the south-west corner of the enclosure wall of Tayok Pyay temple 539, on the north of Minnanthu village; still others are part of wide complexes of temple, stupa, several monastic buildings, ordination hall, pond, etc.

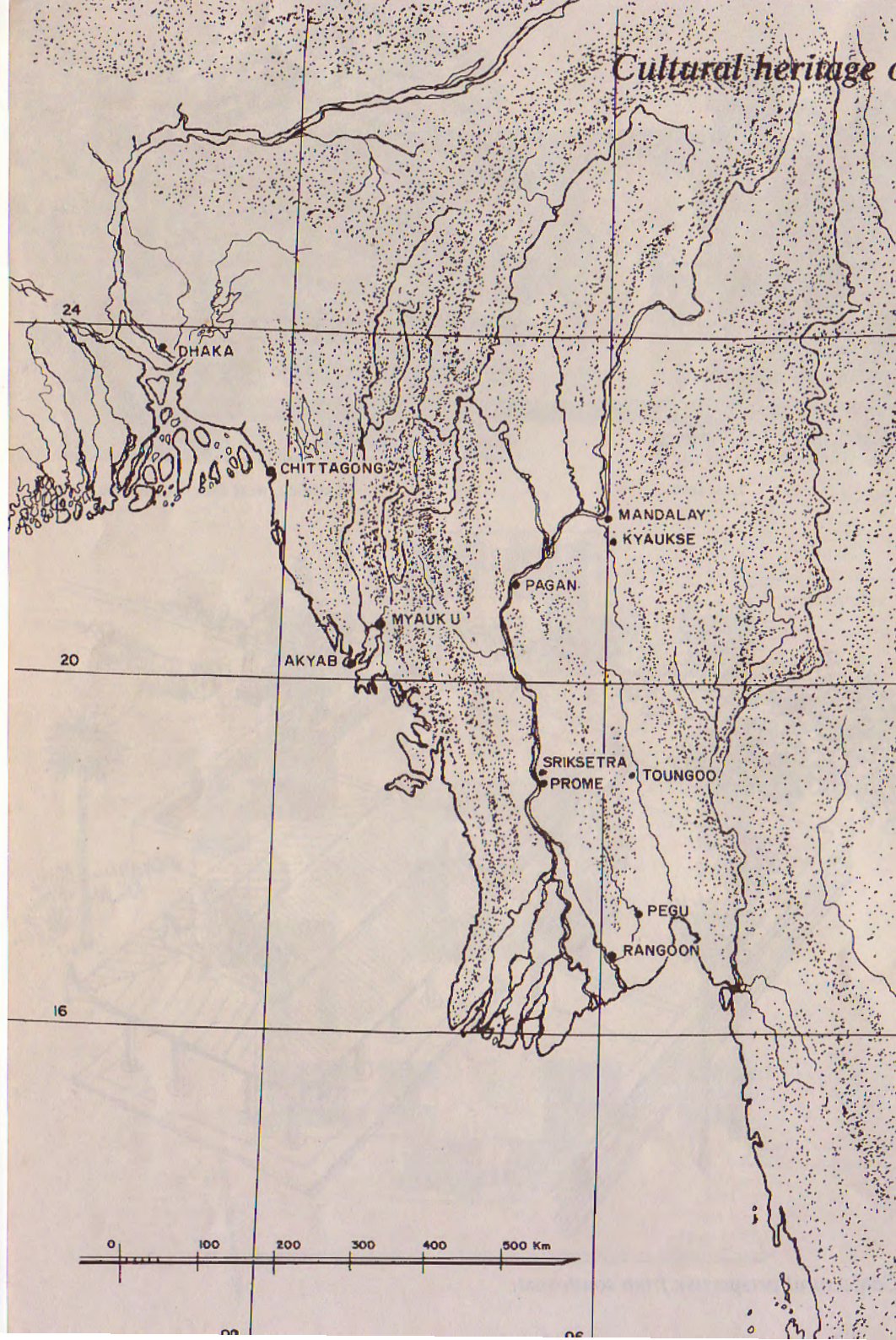
The most common type of monastery is a cubic brick building with two doors on its east side and one door on both the north and the south sides. To the east, in front of the main façade marked by a central niche, was a woodwork extension; only visible today are its stone sockets which were placed under the wooden posts, a stone boundary plinth and the marks of its roofs on the eastern brick wall of the building.

The monastery 540 has in addition three foreparts, on the middle of the south, west and north façades. The plan shows a corridor around a central vaulted room. Some monasteries with similar ground plan are two-storeyed, either with a brick vault on each storey or with a middle floor on wooden beams. The roof is usually flat, as here, and accessible through an interior staircase, but in a few cases there is an upper storey crowned by a square, tiered, brick tower (e.g. monastery 73, see *Pagan Newsletter* 1984).



Conjectural perspective from south-east.

Cultural heritage of Burma: the city of Myauk U (Myohaung)



Today a state in the Union of Burma, Arakan was, for a long time a coastal kingdom with an important role in the history of trade and warfare in the Bay of Bengal. Of its first capital cities, Dhannavati (up to the 4th century AD) and Vesali (8th to 10th centuries AD), few structures remained other than the city walls and moats, yet more are now beginning to appear due to excavations carried out by the Archaeology Department over the last three years.

During the Pagan period, the Arakanese kingdom became a feudatory of the Burmese dynasty.

Myauk U, the last royal capital city of Arakan from 1433 to 1785 AD, is beautifully located near the foot of Arakan Yoma Range, on the inland side of the deltaic plain where a network of rivers provides easy access to the sea.

The city site, measuring around 6.3 km. from south to north and 5.4 km. from west to east, is intersected by steep hill ranges, crowned by numerous stupas, and by creeks, ponds and large artificial lakes; these hills and waterways, at places completed by ramparts, form an impressive and well integrated fortification system.

The royal palace, roughly marking the city centre, was surrounded by three concentric enclosure walls, the outer one with a side of around 600 m. The palace has disappeared long ago, and a small site museum has recently been built where it stood.

In the outer city around the palace enclosure, a great number of religious monuments are scattered, dating mostly from the 15th and 16th centuries AD; they were well built, generally in carefully dressed sandstone blocks, with occasional additions in brick masonry. The stone work is of outstanding quality, particularly on the skilfully voussoired vaults and even on such difficult shapes as oval cupolas. Amongst these monuments are large temples such as Shittaung or Dukawthein, whose severe architecture with its fortified appearance shelters fine stone sculptures. Numerous smaller temples of well balanced design such as Lemyethna (a square building with four foreparts centered on an octagonal core surrounded by a vaulted corridor) or Andaw (an octagonal temple framed by a row of stupas) and elegant stupas like Yatanabon, Pezitaung, Yatana Manaung, etc., are harmoniously located in the picturesque landscape.

Thanks to their sound construction, many of these monuments are still impressive. They are however severely threatened by the aggressive Arakanese climate (more than 400 cm. of annual rainfall, high temperatures, strong winds) and by occasional earthquakes. Due to the lack of manpower, too many monuments are rapidly decaying and are completely overgrown by tropical vegetation (Kotthaung stupa for instance). A permanent maintenance force would be necessary to ensure at least minimal protection of this outstanding architecture. Its survey and systematic recording should also be implemented, as a first step towards further study and actual conservation process.

Selected bibliography:

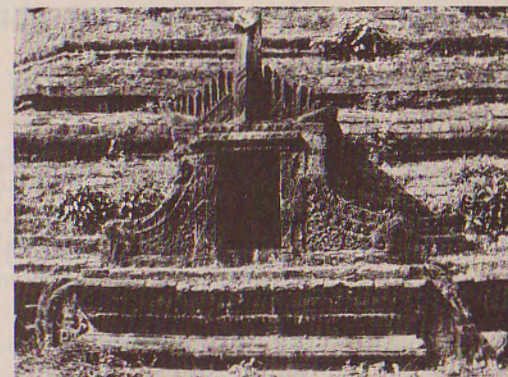
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Shittaung Temple, from south.



Lin Ban Pyauk Stūpa, from north and detail of east niche.



Pittakat Taik, south face and detail of the vault.



Dukawthein temple, from south-east.



Lemyethna Temple, from south.

Two seminars on the conservation of historic monuments in seismic zones

In June and July 1985, two international meetings on the conservation of monuments in seismic areas were held in Yugoslavia: the first one in Petrovac (Montenegro) was a workshop between Yugoslavian and American experts, while the second one in Skopje (Macedonia), a training course jointly organized by Iccrom (Rome) and Iziis (Skopje), attracted extensive international participation, from China, Nepal, Turkey, Syria, Greece, Italy, Peru, Guatemala, Chile, etc.

At both occasions, concrete experiences and case studies were presented and widely discussed, including the programme of seismic reinforcement of the Pagan monuments in Burma.

These final recommendations have been prepared by a selected committee on the basis of the final general discussion at the end of the Iziis/Iccrom seminar:

Thanking the Institute of Earthquake Engineering and Engineering Seismology of Skopje for the interest shown in the problems of historic building by organizing this international course in cooperation with Iccrom and with support of Unesco,

Recognizing that good progress has been made in earthquake engineering in Iziis since its foundation in 1965 and in other institutions all over the world,

Expecting that progress in such studies will continue and that more special interdisciplinary studies on historic building be undertaken so that the "state of art" will improve,

Appreciating that every historic building is unique and deserves special studies, it is recommended:

1. that the structural system of such historic buildings should be respected because it will have already resisted a number of earthquakes,
2. that any new materials and structures used for repair and strengthening should be compatible and durable and that the use of reinforced concrete be restricted,
3. that the degree of protection required should be assessed individually based on the various probabilities of seismic events and the possibility of further strengthening at a future date when better techniques will have been developed,
4. that loss of cultural values should be assessed for different seismic effects involving the formal consideration of alternative projects by engineers, historical architects, archaeologists and art historians,
5. that building owners or occupiers be encouraged and instructed to better maintain the existing structural system and fabric,
6. that a thorough documentation and survey of historic buildings in seismic areas be undertaken and schedule of regular inspections and maintenance be organized,
7. that a microzoning study of seismic risk be undertaken starting with the most vulnerable historic building sites.

Further it is recommended:

1. that experimental and analytical research on the earthquake resistance of masonry and masonry structures be increased with special emphasis on historic building techniques and involving the study of ancient concepts of construction and anti-seismic protection,
2. that research and testing of alternative grout mixes and evaluation of their long-term environmental effect on masonry will be initiated and that mortar mixes that are compatible with the nature of historic buildings be studied,
3. that the effectiveness of reinforcement techniques be evaluated from the actual behaviour of strengthened buildings in earthquakes.

Skopje, July 5th 1985

Information: a small handbook published by Unesco in 1985 provides guidelines and recommendations for conservators and architects in charge of historic monuments and ancient buildings located in earthquake-prone areas:

EMMERGENCY MEASURES AND DAMAGE ASSESSMENT AFTER AN EARTHQUAKE

Unesco, Projects and Documents no. 6. (English and French edition)

It can be ordered from:

ICOMOS DOCUMENTATION CENTRE

75, rue du Temple

75003 PARIS FRANCE

PAGAN newsletter

is published once a year during the Project's duration.

Kindly send us names of interested persons and institutions for inclusion in our mailing list.

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